The Scientist's Uneasy Conscience *

by

MICHAEL SWANN

An eminent British biologist discusses Responsibility in Science in the context of problems that are becoming more important to society than anything else, namely, the effect that science has had on society and the increasing rejection by society of the one force that has, above all others in recent years, done so much for society.

I do not know who was the first scientist pure, or applied, who first felt a twinge of conscience about his pet discovery. I suppose it was someone like the inventor of the wheel, when he saw some war lord incorporating it into a chariot.

Over the millenia, these twinges of scientific conscience must have become severer and more frequent. But at the same time, the power of science for good became so much more apparent that these doubts, by and large, were stilled. And over most of the last century, we have lived in a rosy glow of almost unbounded optimism for mankind, justified and fortified by the accelerating growth of science in every direction.

True, there have been two great wars, made far greater by science than could ever have been dreamed of a century ago. But somehow most people found it possible to regard them as mere passing human aberrations. And after each one, optimism reasserted itself and, hopefully, Western man saw himself once more all set for progress. As recently, indeed, as 1965, the then British Prime Minister campaigned for an election on the ticket of a "white-hot technological revolution" that was going to put everything to rights. As you know, he won, and there were few discordant voices.

Exactly why, in the last five years or so, feelings should have changed so much in the Western world is far from clear. I do not go along with the currently fashionable sentimental notion that it is

* Abridged text of Dunning Trust Lecture delivered at Queen's University on 5 November 1969.

all due to the student revolt — to a brief passing generation who in some mysterious way are more clear sighted and high minded than their elders, and, don't forget, than their predecessors of a few years before. At the most I think the student revolt has simply amplified (or perhaps exaggerated would be a better word) an unease that had been quietly building up for a long time past.

There are, I believe, two sorts of reasons for this unease, what one may call the obvious ones, and the not so obvious ones, and let us look at both of them.

The obvious ones are so sickeningly familiar that I would take them as read, were it not that I want to make a very serious, though unfashionable, and even unpopular, point about them.

We all know, because we hear little else these days, how the scientific revolution has magnified the horrors of war, polluted our earth, air, and water, despoiled the natural and the urban environment with buildings, roads, and motor cars, invaded our privacy, degraded much human labour to robot-like status, magnified intolerably the stresses and strains of life, and through the mass media, lowered and trivialized our standards of life, intellectual, aesthetic, moral. According to one's attitudes, political and religious, one can take one's pick of the indictments.

Well, yes; certainly yes; but also *no*. It's true, a few big bangs could now exterminate large sections of the world's population. But it is also true that there were enough swords, machetes, axes, daggers, pikes, lances, and heaven knows what else at any and every point in history to achieve the same effect. And, of course, before the advent of modern medicine, bacteria could, and often did, do the same job more effectively still.

It's true, too, that an unpolluted, unspoiled environment is highly desirable. But is it more desirable than the starvation, malnutrition, and high mortality that have always accompanied it in the past, and still do so today in the underdeveloped countries? And it's true that much modern labour is a soulless affair. But it has always been thus, and at least most labour in the Western world now supports a tolerable standard of life — tolerable by today's standards, but actually, of course, beyond the dreams of avarice of a labourer even a hundred years ago.

And so on. Against every indictment, we can argue a contrary good. And, personally, I have not the slightest doubt that the good outweighs the bad — handsomely. A few people, of course, genuinely believe it does not. And a good many more people these days affect to believe that it does not. But then, of course, very few of us in the Western world have any actual experience of the bad old days. But people who do, Africans, Indians, all sorts of people

from the really underdeveloped countries, are, of course, in no doubt at all about which they prefer. We have a lot of these men and women in my own University of Edinburgh, as you do, and as they are the only people who see both sides of the coin, I think we ought to be humble enough to believe what they say. And the fact of the matter is that whatever their politics, for every one who indulges in our current brand of scientific technological hypochondria, there are nine — perhaps ninety-nine — who find it not just laughable, but bordering on the insane.

In short, whatever index we care to take of the human condition, whether it is expectation of life, prevalence of disease, extent of starvation or malnutrition, degree of poverty, standards of education, or quality of housing, we find improvements in the last fifty years, and still more in the last ten which, viewed dispassionately, and on the time scale of history, are miraculous.

Our current obsessions with the darker side of the picture, of course, do credit to our hearts, but they do no credit to our heads. In fact, like most obsessions, they have a neurotic element, and like most neuroses, they are liable to deflect us from really getting down to the problem of making things better.

So much for the obvious reasons. A cause for unease certainly, but I don't believe they begin to add up to a case for rejecting the scientific technological society, unless one abandons both reason and all sense of history. And though no one, I think, will admit to rejecting reason, alas, all sorts of people, in a curious alliance that includes archetypal capitalists like Henry Ford, and too many of the current generation of student radicals, are apparently quite happy, and even proud, to regard history as "bunk." At least I would hope that no scientist, if he stops to reflect how crucially every forward step depends on the steps that have gone before, could be so foolish.

But now, if we turn to the not-so-obvious causes of our present troubles, we get nearer, I believe, to understanding. And by the not-so-obvious causes, I mean those situations where the scientific technological revolution has done much undisputed good, but generated in consequence not just some undesirable side effects, but opened up, unexpectedly, new dimensions of trouble.

Curiously enough, we seem to be better at recognizing these situations in others than in ourselves. Everyone, for instance, knows how modern medicine, by lowering the death rate, has brought about a population explosion in countries that were not yet geared up for modern agriculture, nor yet psychologically adjusted to lower their birth rate, with the result that malnutrition merely takes over from disease. I might add in passing that in so

far as the current reproach to rich countries that the rich are getting richer while the poor get poorer has any truth, it is precisely for this reason. And one should perhaps ask anyone who makes this indictment against the Western world, whether he would have withheld modern medicine for another heaven knows how many years while countries built up their agriculture and industry to a level where they could accept modern medicine without crisis.

But this by the way. Very few people, however, seem to realize that the intractability of Western society, its inability to realize anything like the standard of life for all its members that is now theoretically possible, its inability, indeed, to achieve even the most modest reforms in measurable time, has also got to be laid at the door of the scientific revolution. Not wholly, of course. These problems are as old as social life; but science has raised them to an altogether higher level of intractability. For the simple reason that in a society where almost everyone is educated up to a point and hence articulate; where almost everyone is healthy, and hence active; and where everyone is up to a point affluent, and hence economically significant; then almost everyone is politically significant. They can and they do make their views felt.

And this is not all. For modern communications make possible a vastly more complex structure of social groupings, spread throughout society and capable of rapidly mobilizing political pressures. The result is the familiar present-day world, where social life seems to have an impetus (or perhaps that is the wrong word — very often it's more like an inertia) that is all its own, and that defeats both individuals and governments of whatever persuasion. Indeed, as the radical young are well aware, scientific technological life is much the same, be the reigning government Left, Right or Centre.

This, I am sure, is the real reason why so many people today feel sometimes despondent and sometimes desperate — or to use the exaggerated language of the radicals, alienated. It is the not unexpected result of making *everybody* count in fair measure. Put another way, "when everyone is somebody, then no one's anybody." Which no doubt you will recognize as the highly authoritarian Grand Inquisitor's rebuke to the ultra-democratically inclined and egalitarian kings of Barataria, in Gilbert & Sullivan's opera *The Gondoliers*. Indeed, humanity has been here before, and history, alas, is not "bunk."

Now I'm sorely tempted at this point to fly off at a tangent and explore further the fascinating, if gloomy, topic of how the scientific revolution is making the democratic way of life steadily more difficult, and the alarming possibility that the currently fashionable

cure for alienation, namely even more democracy, with participation in every known direction, will in fact make things more intractable still, by letting even more people object to progress.

I suppose that some day a bunch of social scientists will construct a series of graphs that will quantify the responsiveness and the rate of decision-making as a function of the size of committees; and relate the happiness of individuals to the responsiveness and rate of decision-making of the said committees, and conversely quantify the increasing degree of trouble and frustration caused by leaving increasing numbers of people out of the decision-making process. And where all these curves cross each other in some multidimensional process of analysis, then we shall have the recipe for perfect government.

Meanwhile, we can usefully read Plato, who thought most of these problems through about twenty-five hundred years ago. And we can usefully resolve to contribute as best we may to the effectiveness of government by setting out the arguments for doing whatever we think ought to be done in strictly rational fashion. For only thus can we even hope to avoid all the emotional counter-arguments for doing nothing — and this is a point I shall come back to.

After this long digression, let me come back to the point where we started — the scientist's conscience. Well, I believe he has done much for humanity, and he can fairly feel a little proud of it. But equally, he has generated a lot of troubles in the process, and his conscience indeed *ought* to be uneasy. What, if anything, does he do about it?

Simply because the scientific revolution has brought problems in its wake, it doesn't automatically follow that the scientist himself has got to do *anything* about it. He could obviously be the wrong man to do something about it. We don't, for instance, expect that motor car manufacturers should plan the roads, or organize the casualty units that their activities undoubtedly render essential. This is not their field, they are not competent, and, rightly, we regard it as up to society to shoulder this responsibility.

This, of course, is a comforting argument for scientists, and they have adopted it with alacrity. You know how it goes: science itself is neither good nor bad, only society puts science to good or bad uses. Although, having read countless grant applications in my day, I have to say it is my impression that there are a few scientists who hesitate to point out very firmly the possible important and valuable implications of their projected work.

Following this line of thought, then, scientists can, and do, work away in their labs with a clear conscience (or perhaps it

would be more honest to say without a conscience at all), secure in the feeling that if ill results, it is not their fault, but the fault of society. Conversely, one cannot help feeling, if good results, the credit ought to be society's and not theirs. But this, curiously enough, is not a conclusion one ever hears drawn. All of which presumably goes to show that scientists are no more logical or honest than the next man.

This approach is not peculiar to scientists. It is indeed at the root of the liberal conception of universities that we, in Britain, and you on this side of the Atlantic, have adopted from the German universities of the last century, and now built in, so powerfully, to university thinking. Other conceptions of a university, of a place to train an élite how to think, as expounded by Cardinal Newman, or of a centre for professional vocational practical subjects, stemming particularly from Scotland and the American Land Grant Colleges, both of these conceptions survive. But they have been extensively overlaid by the cult of pure scholarship, unsullied by the demands of government and everyday life.

Nowadays, of course, this has begun to look rather detached and selfish. But it is an idea that rested on the largely valid assumption, implicit if not explicit, that this was indeed the way to a better world. Only if thought was unchecked by dogma and practical distractions could truth be arrived at. And it is indeed so. But underlying everything was the further assumption that the fruits of scholarship would be wisely applied by lesser mortals — politicians, industrialists, and the rest.

And so, by and large, they were, at least for a time. How else would our expectation of life have been doubled? But we have now reached a stage where this underlying assumption no longer holds. The rise of science has generated problems that are as difficult as, and perhaps *more* difficult than, the problems that science first set out to solve. And these problems moreover, are often, and perhaps more often than not, essentially scientific ones.

Scientists therefore are no longer like motor car manufacturers, whom no one expects to plan cities or run hospitals. They have generated problems of a type to which they, and often only they, can and therefore should contribute solutions.

In practical terms, what does this imply? I am not going immediately to try to answer that question, but rather to tell you, by way of illustration, as a model system if you like, about one science-engendered problem. It is not one of the great problems of our day. As these problems go, it is really quite a minor one. It simply happens to be one that in the last year I have learnt a lot about. And perhaps because it is not too complicated a problem,

one can get to grips with it in a fairly complete way. Anyway, I think it illustrates rather simply most of the things I have been talking about. It is a problem of the use, or rather the misuse, of antibiotics, and a few weeks ago I, and half a dozen colleagues in Britain, finished writing a report about it to the government.

As you know, antibiotics are very powerful substances, with the remarkable property of killing bacteria, while having little or no effect on human beings or animals. A lot of different ones have been discovered, and they have revolutionized the treatment of disease. But, as so often, there are snags. For although they kill *most* bacteria, a few so-called resistant ones are liable to escape and multiply, making further treatment impossible; so that constant and indiscriminate use of antibiotics is liable to defeat its own ends. Doctors have long realized the dangers, and this is why they are, or should be, reluctant to give you antibiotics unless you really need them.

But nowadays nearly half the antibiotics consumed in Britain, and I imagine in Canada, go into animals, either for controlling disease or (a curious side effect of antibiotics) for promoting better growth. And because there is much to and fro between the bacteria of animals and the bacteria of man, it can theoretically happen, and on occasion does actually happen, that bacteria made resistant to antibiotics in animals, proceed to cause disease and death in humans. This is the problem that I, with the help of half a dozen expert doctors, vets, and agriculturalists, was asked to look into.

There are, predictably, some over-simple reactions to the problem, and we were indeed subjected to them very briskly: the practice of giving antibiotics to farm animals only puts money into the pockets of farmers and drug firms, and if a single human being dies as a result, it should be prohibited; or alternatively, the whole problem is much exaggerated, the resultant good is considerable, so nothing needs to be done at all.

Neither of these attitudes, it seemed to us, will do. Any human deaths that can be prevented, should be prevented. But suppose that the giving of antibiotics to animals were to be banned, what would follow? First of all, vast numbers of animals would fall sick and die, as they used to twenty or thirty years ago. And though almost everyone would rate human suffering and death as a greater ill, it would be a bold and harsh man who would unhesitatingly say that a million animals should die for the sake of one human — which is probably the order of magnitude of the problem.

This is not by any means the end of it, however. For if we did not use antibiotics on the farm, we should produce a great deal less

food than we do. Since Britain, and Canada, are rich countries, this would not matter so very much to us. But all over the world there are millions dying of starvation, and hundreds of millions undernourished. It is *they* who would have a little less to eat.

It is not, then, very difficult to conclude that a complete ban on antibiotics for animals would be wrong. And the bulk of our report consists of a detailed investigation, taking account of all the possible benefits, and all the possible dangers, of how to maximize the good and minimize the ill.

The time has clearly come for the development of a strategy for the use of antibiotics — restricting the use of some in varying degrees, while allowing the free use of others. We need to know much more about epidemiology, particularly of animal diseases, with a view to limiting the spread of infections. We need to know more about animal husbandry so that we need less antibiotics, and find other and less dangerous means of growth promotion. We need better monitoring services. We need more vets knowledgeable about all the problems involved.

The difficulties ramify out in every direction, but if we are to get the full reward for the discovery of antibiotics, we have got to attack them. So, by way of conclusion, let me try to pull all this together in a wider context — and it doesn't only apply to modest problems like antibiotics on the farm — it applies to every problem of present-day society.

In the first place, I believe that scientists have got to subject these science-generated problems to the sort of dispassionate scrutiny they would give to primary scientific problems. First, because it's the way to solve them. And secondly, because only by doing so, and exposing the real nature of the problem to public view, can we hope to penetrate the ethical and political confusion that surrounds every major human problem. Only if we do so, and do it really dispassionately, can we hope to counter the arguments and persuade the arguers, who, from endless different viewpoints, would have us do either nothing or the wrong thing. Now whether, in this really not very important problem I have been talking about, we have really succeeded in doing this, I do not know. But at least all the facts are there, the remedies are argued out, and I do not believe that any honest drug manufacturer can now say that nothing should be done, or any honest sentimentalist can say that antibiotics be banned from the farm. Or if they do, I do not think they will muster much support.

What I am trying to say was, I think, rather well set out, right at the beginning of our report, by the civil servant who actually did the drafting. And it so exactly catches what we were trying to

do, and what I believe has to be done, that no one wanted to alter it — which is unusual when it comes to writing reports by committee. This is what he said: "Solutions to such problems come not from dwelling on the ethical dilemma, but by scientific dissection of the basic problems . We have attempted to explain in simple and straightforward terms how the use of antibiotics in animals may affect both humans and animals. This has involved setting out both the benefits, and the dangers which may arise . . . We have sought solutions in this way to the problems posed " and so on.

In passing I should only add that while I believe there is no use in *dwelling* on the ethical dilemmas, and still less use in *wallowing* in them — which is what a lot of people seem to like doing today — the fact remains that there *are* ethical dilemmas, plenty of them, everywhere. And a scientific dissection that is carried out in ethical darkness as you might say, isn't likely to get us anywhere much. But that sounds like the material for another series of Dunning Trust lectures.

The next point I want to make, and it stares out from every corner of the antibiotics problem, is that science-generated problems also generate a need for more science — for more research. I mentioned a few of these problems — more antibiotics, more knowledge of animal epidemiology, more understanding of good husbandry so that antibiotics are not needed, and so on. In short, scientific discoveries not only need applied scientists to bring them into the service of mankind; they need a second wave of applied scientists to deal with all the problems that then arise. Does this, I wonder, imply that we have got slowly to achieve a new balance between pure and applied science, weighted much more in the direction of the latter? I suspect it does, and that science policy will gradually have to take this one on board.

And lastly, I believe we have all got to accept that even the simpler science-generated problems are not in reality simple and that there are, therefore, no simple solutions. Instant utopias were never on, but the scientific technological age, if it has done nothing else, has finally exploded this pathetic, if rather endearing and child-like, myth. An awful lot of people have got to work very hard for a very long time to make things better, and no one has to work harder than the scientists. In conclusion, I would only say that I believe a university has no more important job than to get across to its students the most painful lesson mankind has learnt throughout civilization, that there *are* no short cuts to a golden future.